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WR 25 and WR 140 in X-ray relation to η Carinae

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WR 25 (WN6ha+O) and WR 140 (WC7+O5) are both X-ray bright binaries of long period and high eccentricity, whose individual stellar and wind and collective binary parameters are much better known than those of η Carinae. Observations at different orbital phases thus show how X-rays are produced by colliding winds under physical and geometrical conditions that are quite well defined at any one time but which vary considerably around the orbit. As WR 25 is $7'$ from η Carinae, there are more observations than would otherwise be the case, a few of which during the 2003 *XMM–Newton* campaign led to the recognition of brightness and absorption variations that were soon shown to coincide with a periastron passage of the 208-day $e \approx 0.6$ optical radial velocity orbit discovered by Gamen et al. 2006, *A&A* 460, 777. Their orbit was used in early 2008 to plan a month-long daily ToO campaign with the soft X-ray XRT instrument aboard the *Swift* GRB Observatory. As well as the relatively shallow eclipse by the extended Wolf-Rayet wind, a sudden overall decrease between quadrature and conjunction is most obviously interpreted as a stellar eclipse by the WN6ha primary, thought to be one of the most massive stars in the Galaxy. Repeatability is good within the relatively modest statistical limits of the few dozen measurements available, spread unevenly over several cycles. The luminosity increases monotonically between apastron and periastron from the surface that provides the backdrop for the eclipses. Observing conditions for WR 140 are more favourable. It has an orbit well-established by Marchenko et al. 2003, *ApJ*, 596, 1295, of longer 7.94-year period and higher $e \approx 0.881$ eccentricity. It is also a brighter X-ray source. As a result, measurements are more precise and the phase density much higher. Weekly hard X-ray monitoring with *RXTE* started just before the 2001 periastron passage, increasing to daily measurements in the approach to the 2009 periastron with recent measurements also made with *Swift*, *Suzaku* and *XMM–Newton*. Preliminary analysis of the *RXTE* data show the same general type of eclipse events seen in WR 25 but in greater detail and with significant differences. For example, the luminosity maximum apparently occurs a few weeks before periastron and even before conjunction. with asymmetries before and after periastron. The adiabatic $1/D$ luminosity law gives a poor description throughout the orbit and there were no obvious flares like those seen in η Carinae. High resolution *Chandra* data obtained at 4 phases show very small changes in shape between apastron and O-star conjunction in a spectrum dominated, perhaps surprisingly given the expected collisionless nature of the shocks concerned, by a smooth continuum probably from hot electrons. The lines imply complete mixing of shocked material from both winds. Details of the velocity profiles are more difficult to understand, especially the absence of the highest velocity blue-shifted material near periastron.